U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

PB-260 155

PRELIMINARY REPORT ON WATER QUALITY AND USE ASPECTS OF THE PRICE RIVER BASIN IN EAST CENTRAL UTAH

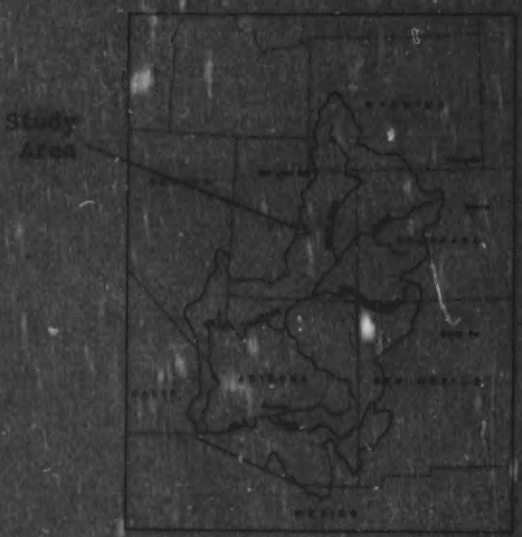
PUBLIC HEALTH SERVICE, DENVER, COLORADO

MAY 1963

215145

PB 260 155

PRELIMINARY REPORT ON WATER QUALITY AND U.S. ASPECTS OF THE PRICE RIVER BASIN IN EAST CENTRAL UTAH



U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service, Region VIII
Denver, Colorado

In Cooperation with the

DEPARTMENT OF THE ARMY
U. S. Army Engineer District - Los Angeles, California

MAY 1963

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U. S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

BIBLIOGRAPHIC DATA SHEET	1. Report No.	2.	3. Recipient's Accession No. PB-260 155
4. Title and Subtitle Preliminary Report on Water Quality and Use Aspects of the Price River Basin in East Central Utah.			5. Report Date May 63 6.
7. Author(s)			8. Performing Organization Rept. No.
9. Performing Organization Name and Address Public Health Service, Denver, Colo. Div. of Water Supply and Pollution Control			10. Project/Task/Work Unit No. 11. Contract/Grant No.
12. Sponsoring Organization Name and Address Army Engineer District, Los Angeles, Calif.			13. Type of Report & Period Covered 14.

15. Supplementary Notes Prepared in cooperation with Army Engineer District, Los Angeles, Calif. Report on Colorado River Basin Water Quality Control Project.

16. Abstracts A reconnaissance survey of multipurpose water development possibilities in the Price River Basin is described that included the study of the possible need for water storage in potential reservoirs for flow regulation to insure downstream water quality. It was found that total water demands for municipal, industrial, irrigation, and water quality control purposes on a single-use basis already exceed presently available supplies during low flow years and projected total water demands may exceed the potential supply. It is recommended that surface waters should be stored to deal with probable economic growth demands, and determination of the value of water in the upper reaches of the Price River, above Price, Utah, for municipal supply and other purposes be made.

17. Key Words and Document Analysis. 17a. Descriptors

17b. Identifiers/Open-Ended Terms

Price River
*River basins
Utah
Rivers
*Water quality
Water quality data
*Water supply
Water reservoirs
Economic forecasting
Community development
Tables(Data)
Stream flow

17c. COSATI Field/Group 13B

18. Availability Statement	19. Security Class (This Report) UNCLASSIFIED	21. No. of Pages 57
	20. Security Class (This Page UNCLASSIFIED	22. Price

PRELIMINARY REPORT ON WATER QUALITY AND USE ASPECTS OF THE PRICE RIVER BASIN IN EAST CENTRAL UTAH

Study of Potential Needs of Water
for Municipal, Industrial, Irrigation
and Quality Control Purposes

Prepared
In Cooperation with the District Engineer,
U. S. Army Engineer District, Los Angeles, California

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service, Region VIII
Bureau of State Services
Division of Water Supply and Pollution Control
Colorado River Basin Water Quality Control Project
Denver, Colorado

May 1963

C O N T E N T S

	Page
SUMMARY	i
CONCLUSIONS AND RECOMMENDATIONS	iv
ACKNOWLEDGMENTS	v
BASIS FOR THE REPORT AND EVALUATION CRITERIA	1
DESCRIPTION OF THE STUDY AREA	4
PRESENT ENVIRONMENT AND ITS HISTORICAL DEVELOPMENT	6
The Economic Base	6
Hydrology	14
Total Water Demand	15
Pollution Sources	19
Water Quality	21
PROJECTION OF SELECTED ENVIRONMENTAL CONDITIONS	25
Projection of Most Probable Economic Development, 1960-2060	25
Projected Water Requirements	32
Anticipated Waste Discharges	35
Future Water Quality Considerations	36
Streamflow Regulation Requirements	37
BIBLIOGRAPHY	
APPENDIX	

LIST OF TABLES

Table No.		Page
I	Population Distribution by Census Enumeration Units, Carbon County, Utah, 1940-1960	7
II	Population and Labor Force Characteristics, Carbon County, Utah and the State of Utah, 1940-1960	9
III	Total Civilian Labor Force, by Major Industry Categories, Carbon County, Utah, 1940-1960	10
IV	Comparison of Economic Activity in Carbon County and the State of Utah during 1961	14
V	Flows in the Price River, 1946-1960	16
VI	Summary of Present Water Use in the Price River Basin in East Central Utah for 1960	17
VII	Waste Sources in the Price River Basin	20
VIII	Chemical Analyses of Streams	22
IX	Summary of Population, Labor Force, and Employment Projections, Carbon County, Utah, 1960-2060	28
X	Projected Population Trends by Socio-Economic Orientation, Carbon County, Utah, 1960-2060	29
XI	Projected Aggregate Demand by Major Water Use Categories, Price River Basin, 1960-2060	33
XII	Projected Price City and Adjacent Areas Municipal and Industrial Water Demand, Price River Basin, 1960-2060	34
XIII	Dilution Water Required to Maintain 2 ppm Dissolved Oxygen Below Wellington	38

SUMMARY

The Corps of Engineers is currently engaged in a reconnaissance survey of multipurpose water development possibilities in the Price River Basin. In conjunction with this survey, the Corps of Engineers requested the Public Health Service to carry out a preliminary examination of present and future aggregate demands for municipal, industrial, and irrigation water supplies. In addition, it was requested that the possible need for water storage in potential reservoirs for flow regulation to insure downstream water quality be investigated. No attempt was made in this report to adjust projections of possible future growth to take into account the probable constraints likely to be imposed by a limited developable water supply, since data on the hydrologic yield potentially available for storage in the Price River drainage system has not yet been developed.

The Price River, a tributary of the Green River, drains a land area of approximately 1.5 million acres in east central Utah. This area includes 64 percent of Carbon County, 16 percent of Emery County, and smaller portions of Duchesne, Sanpete, Utah, and Wasatch Counties. All of the soils of the study area have been modified by fluvial and eolian action. Large areas are underlain by Mancos shale. The study area has an arid climate where rainfall averages less than 10 inches annually. Excellent transportation facilities have been developed, including major transcontinental highway and railroad connections, pipelines, and an airport at Price, Utah.

Almost all of the study area's population and economic activity are centered in Carbon County. The evaluation of past and present economic conditions was therefore limited to this portion of the study area. A peak population was reached in 1950 when the census recorded 24,901 persons living in Carbon County; by 1960 the total population figure had dropped to 21,135. Unemployment has been a major problem in the study area for at least 10 years; in 1960 an average of 9.4 percent of the labor force was unemployed. Carbon and Emery Counties have been designated as a redevelopment area by the Area Redevelopment Administration of the U. S. Department of Commerce.

Mineral production (mostly coal mining), irrigated agriculture in support of a livestock industry, and recreation-oriented commercial activities are the major sources of basic income in the study area. Manufacturing is still a relatively minor sector of the local economy but has expanded at a moderate rate in recent years. Development of water-oriented economic activity, including irrigated agriculture, has been hindered by a limited dependable water supply of suitable quality.

The average flow of the Price River near Heiner, Utah is approximately 92,000 acre-feet annually. All of the irrigation water supply and approximately 40 percent of municipal and industrial water demands are met by diversions from the Price River system. Total demands for all municipal,

industrial, and irrigation use amounted to an estimated 55,000 acre-feet in 1960. An estimated 50,000 acre-feet of this overall total was obtained through diversion from surface waters in the Price River system. The remainder was obtained from groundwater sources. Agriculture is by far the largest water user; during a 19-year period of record (1942-1960), gross diversions from the Price River system for irrigation averaged 60,240 acre-feet, which exceeds the total water use recorded in 1960. Overall consumptive use in the study area is estimated to range from 30 to 40 percent of total annual withdrawal.

Pollution of instream waters due to introduction of untreated municipal wastes and salts in irrigation return flows is presently occurring in the study area. The water in the Price River above Helper (the first major upstream population center) is of satisfactory quality for municipal and for most industrial uses. Below the confluence of the Price River and Gordon Creek and after the point of major diversion, the instream water is unfit, in terms of quality, for municipal uses and for industrial purposes, except perhaps for coal washing and cooling. High dissolved salt concentration in the instream water below Price limits its use for irrigation to high salt tolerant crops.

No ground water supplies are being polluted from economic activity in the Price River Basin at the present time or likely to be affected in the future. Local wells generally are naturally high in salt content, especially those in Mancos shale areas, and are usually not used for domestic water supplies. Some spring water sources, however, are of good quality and are used for domestic water supplies. Price, Utah, for example, obtains most of its domestic water supply from springs at the present time.

The area's population is expected to increase to 28,800 by 1980 and to 64,500 by 2060. Total water demands for municipal, industrial, and irrigation purposes are estimated to rise from the present of 55,000 acre-feet for 1960 annually to 120,000 acre-feet annually by 2060. The table below shows a breakdown of these demands. Potential future demands for municipal, industrial, and irrigation water appear therefore to exceed the normal available supplies. It is possible that they also exceed developable storage but without hydrologic yield data, and a determination of potential reuse, this relationship cannot definitely be determined at this time.

SUMMARY OF PROJECTED AGGREGATE WATER DEMAND
ACRE-FEET PER YEAR

	1960	1970	1980	1990	2000	2020	2060
Municipal	5,480	6,100	8,100	11,200	14,700	16,800	21,700
Industrial	7,500	7,700	16,600	27,800	41,300	45,400	48,300
Irrigation	42,177	52,500	50,000	50,000	50,000	50,000	50,000
	55,157	66,300	74,700	89,000	106,000	112,200	120,000
Flow Regulation[1/]	-	-	-	1,900	8,400	11,300	17,500
Total	55,157	66,300	74,700	90,900	114,400	123,500	137,500

1/ These figures were calculated for maintaining 2 ppm dissolved oxygen, and would be the minimum dilution water required in the Price River below Wellington.

The water quality in the Price River deteriorates rapidly below the confluence with Gordon Creek with an increase in total dissolved solids. This results from irrigation return flows and natural drainages. Municipal and industrial wastes are not anticipated to be a problem during the near future, since the wastes from the area from Helper to Wellington will be treated. In the distant future, high municipal and industrial waste discharges, even after treatment, will result in oxygen deficiencies in the Price River below Wellington. In view of the absence of economic and recreational uses of the Price River below Wellington, the Public Health Service has used 2 ppm dissolved oxygen as the minimum level in the Price River to avoid nuisance conditions. To maintain this level of quality, preliminary calculations of the minimum requirements for flow regulation for water quality control needs amount to 1,900 acre-feet by 1990 with an increase to 17,500 acre-feet by 2060 (see preceding table). The benefits for this storage were not computed but the minimum value would be equivalent to the cost of storage for this purpose.

CONCLUSIONS AND RECOMMENDATIONS

Quality and quantity aspects cannot be separated when planning for optimum development of an area's water resources. Since many diverse interests in the project area are involved, it is essential that water resource development aspects pertaining to both the health and general welfare of residents in the project area, and the Nation at large, be given due consideration.

In the Price River Basin, total water demands for municipal, industrial, irrigation, and water quality control purposes on a single-use basis already exceed presently available supplies during low flow years and projected total water demands may even exceed the potential supply. Furthermore no significant additions from ground water supplies appear feasible. The value of water for these future uses can be expected to be high enough to allow for the development of additional storage of the surface waters in the study area. Further detailed study of the growth development potential, hydrologic yields, and reuse possibilities of water resources in the Price River Basin should be undertaken if the project study is carried to a more advanced stage.

It is recommended that:

1. Storage of surface waters to meet present and future demands should be effected to allow the probable economic growth to be realized.

2. Determination of the value of water in the upper reaches of the Price River, above Price, for municipal supply and other beneficial purposes, should be made when a project feasibility study is undertaken by the Corps of Engineers.

ACKNOWLEDGMENTS

This investigation of the water supply and quality aspects of the Price River Watershed was aided materially by information and assistance obtained from a number of government sources, researchers in several universities, and local residents in the study area. Permission of the Bureau of Reclamation to use economic projections for Carbon County, Utah, which were prepared at their request by the Bureau of Business and Economic Research, University of Utah, is gratefully acknowledged.

Special note is taken of the contributions of the following agencies to the overall study effort:

The Price River Water Improvement District, Helper, Utah

Manti-LaSal National Forest, Forest Service, U. S. Department of Agriculture, Price, Utah.

Central Utah Project Office, Bureau of Reclamation, U. S. Department of Interior, Provo, Utah.

Extension Service, U. S. Department of Agriculture, Price, Utah.

County Officials, Carbon County, Price, Utah.

City Officials, Price, Utah.

Secretary, Price Canal System, Price, Utah.

Soil Conservation Service, U. S. Department of Agriculture, Price, Utah.

Bureau of Land Management Office, U. S. Department of Interior, Price, Utah.

Economic Research Service, U. S. Department of Agriculture, Logan, Utah.

University of Utah, College of Business, Department of Fuels Research, Salt Lake City, Utah.

Utah Geological Survey, Salt Lake City, Utah.

Bureau of Reclamation, Region 4, U. S. Department of Interior, Salt Lake City, Utah.

Utah State Health Department, Salt Lake City, Utah

BASIS FOR THE REPORT AND EVALUATION CRITERIA

INTRODUCTION

This report presents a preliminary examination of present and probable aggregate future demands for water supplies in the Price River Basin in east central Utah. It includes also a discussion of water quality considerations and an evaluation of possible need for providing water storage for flow regulation to maintain a desired level of water quality in the Price River system. A physical description of the study area is provided. A section summarizes the present environment and its historical development; this includes a review of the area's economy, hydrology, pattern of water use, level of waste treatment, and current water quality. The last section presents a projection of probable development of the study area that would be possible if water of suitable quality and quantity can be provided to foster such growth. The year 1960 was used to represent the present situation and projections for 100 years, to the year 2060, were developed.

AUTHORIZATION FOR THE STUDY

Request for an investigation and a report of findings by the Public Health Service, U. S. Department of Health, Education, and Welfare, was made by the U. S. Army Engineer Los Angeles District, Corps of Engineers. This request was made by letter dated June 22, 1962, and subsequent correspondence, asking for assistance in carrying out provisions set forth in the Water Supply Act of 1958 (Title III, Public Law 500, 85th Congress) for implementation of water supply programs, and for an evaluation of needs and benefits applicable to flow regulation for control of stream quality as provided for in the Federal Water Pollution Control Act (section 2(b), Public Law 660, 84th Congress, as amended by Public Law 87-88, approved July 20, 1961). An evaluation of benefits was not to be carried out at this time, as certain economic and technical data had not been developed. This report, therefore, provides preliminary findings and is not to be considered a final report on the Price River Basin.

The study area is an integral part of the Colorado River Basin currently under study by the Colorado River Basin Water Quality Control Project, U. S. Public Health Service, Region VIII, Denver, Colorado. One of the objectives of this basinwide effort is to develop a plan for long-range water quality management. A phase of this study covers the Green River Sub-Basin which includes the Price River drainage area.

Since the Price River investigation covered in this preliminary report was made in advance of field investigations planned for in conjunction with establishment of a water quality control program for the Green River sub-Basin, certain materials and preliminary conclusions presented in this report are contingent upon later confirmation. These data nonetheless provide a basis for a more detailed study of the water resource development possibilities in the Price River drainage area.

LIMITATIONS OF ANALYSIS

A note of caution is in order regarding potential uses of the data and conclusions contained in this report beyond the use for which they were developed. Although conclusions were based on an analysis of all readily available information, they were developed, nonetheless, without detailed consideration of the probable effects of national and regional growth on the future economy and water use pattern of the local study area. Its geographic extent is too small to allow for adequate consideration of these external factors. The data presented are aggregate in nature and represent the most probable development within the area if adequate water supplies of suitable quality are developed. These preliminary findings, therefore, can serve only as a general guide to local development possibilities.

BASIC ASSUMPTIONS

The economic, water demand, and water quality projections were developed under the general assumptions previously prepared for use in the overall comprehensive planning effort for the Colorado River Basin. These are summarized as follows:

1. The timely availability of water of suitable quality to support the projected economy without being a constraint to future economic growth will be maintained.

2. During the projection time period, the Nation and the Colorado River Basin will experience a relatively high level of employment, a stable general price level, normal weather, and a continuation of the current relative needs of the civilian economy and national defense. These needs will be fulfilled by continued development and adoption of technology consistent with a rapidly growing population.

3. National production and product requirements will tend toward an equilibrium under reasonably competitive conditions and the Colorado River Basin will share in the gross national product to the full extent of any competitive advantages for producing specific products and services that it may possess.

Reproduced from best available copy.

4. Probable future social, legal and institutional changes affecting water use in the Colorado River Basin can be estimated.

WATER QUALITY EVALUATION CRITERIA

Water quality is now recognized as one of the most important variables taken into account in stream flow system design and evaluation. Water quality becomes of critical importance in planning for development of water supplies in areas where future demands cannot be met unless frequent reuse of this water can occur as it moves downstream. This is the usual situation in planning for water resource development in arid areas of the United States.

The Federal Water Pollution Control Act Amendments of 1961 (P.L. 87-88) authorizes the provision of storage in Federal reservoirs for the regulation of river flows for pollution abatement purposes and directs Federal agencies planning and constructing such reservoirs to seek the advice of the Secretary of Health, Education, and Welfare regarding the need for and value of such storage. It stipulates, in addition, that storage for stream flow regulation for water quality control shall not be considered a substitute for adequate treatment. Where the benefits from such regulation are of widespread nature, the costs of providing it shall be non-reimbursable. Carrying out the requirements stated above involves three separate considerations: 1. A determination of the critical flow in the stream against which protection is to be sought; 2. A determination of the quality level desired during the critical periods; and 3. A determination of the value of storage for water quality control and of the scope of benefits from such storage. Item three has not been worked out in this report because the Corps of Engineers project is preliminary in nature.

MAJOR SOURCES OF DATA

The comprehensive body of statistical and narrative information used in the development of this report was obtained from numerous sources. These included official reports and review comments obtained from other Federal agencies and from state agencies; economic studies underway at the University of Utah, and from limited field investigation. A complete listing of published data sources is contained in the bibliography. In addition, this report is taken from an earlier unpublished working paper of the same title and is on file in the Colorado River Basin Water Quality Control Project Office.

DESCRIPTION OF THE AREA

The Price River, a tributary of the Green River, drains a land area of approximately 1.5 million acres in east central Utah (Figure 1). This area includes almost 64 percent of Carbon County, 16 percent of Emery County and smaller portions of Duchesne, Sanpete, Utah, and Wasatch Counties. The Price River is approximately 150 miles in length; it rises on the east slope of the Wasatch Mountains in southeastern Utah County and northwestern Sanpete County. It flows into the Green River approximately 18 miles upstream from the town of Green River, Utah in Emery County. Scofield Reservoir is located on the headwaters of the Price River.

The headwaters of the Price drainage system rise in the Wasatch Mountains at elevations exceeding 9,000 feet. The river has a steep gradient in the upper reaches and only a slight gradient in the lower two-thirds of its length. It drops to an elevation of approximately 5,500 feet at the City of Price and to approximately 4,400 feet at its confluence with the Green River.

The portion of the drainage area lying in Utah and Sanpete Counties and that portion lying to the west of Price in Carbon County is included in the Wasatch Mountains and is extremely rough with narrow side valleys of steep gradient. The area to the north and east of Price in Wasatch, Duchesne and Carbon Counties derives its drainage from the west Tavaput's Plateau. A broad valley, averaging from 10 to 15 miles in width but without a well-defined central drainage, enters the Price valley from the south at Wellington. The smaller Clark valley enters the Price valley near the Carbon-Emery County line where the Price valley narrows again to an average of 5 to 8 miles. The lower southeast portion of the drainage area within Emery County is a dissected plateau, averaging six to seven thousand feet in elevation. For the last 20 miles above its confluence with the Green River, the Price River flows through a narrow canyon cut through the Book Cliffs and Beckwith Plateau.

The soils of the Price area were derived from either alluvium or residual materials. All have been modified by fluvial and eolian action. Agradation and degradation in the flood-plain areas is a constantly recurring process. Large areas are underlain by Mancos shale. The drainage area is typical of much of the arid topography of Utah. Its soils contain high levels of salts and other minerals which dissolve readily upon contact with water.

The area has an arid climate; rainfall at Price averages less than 10 inches annually. The frost free period averages 5 months with this period normally extending from early May to early October.

4a

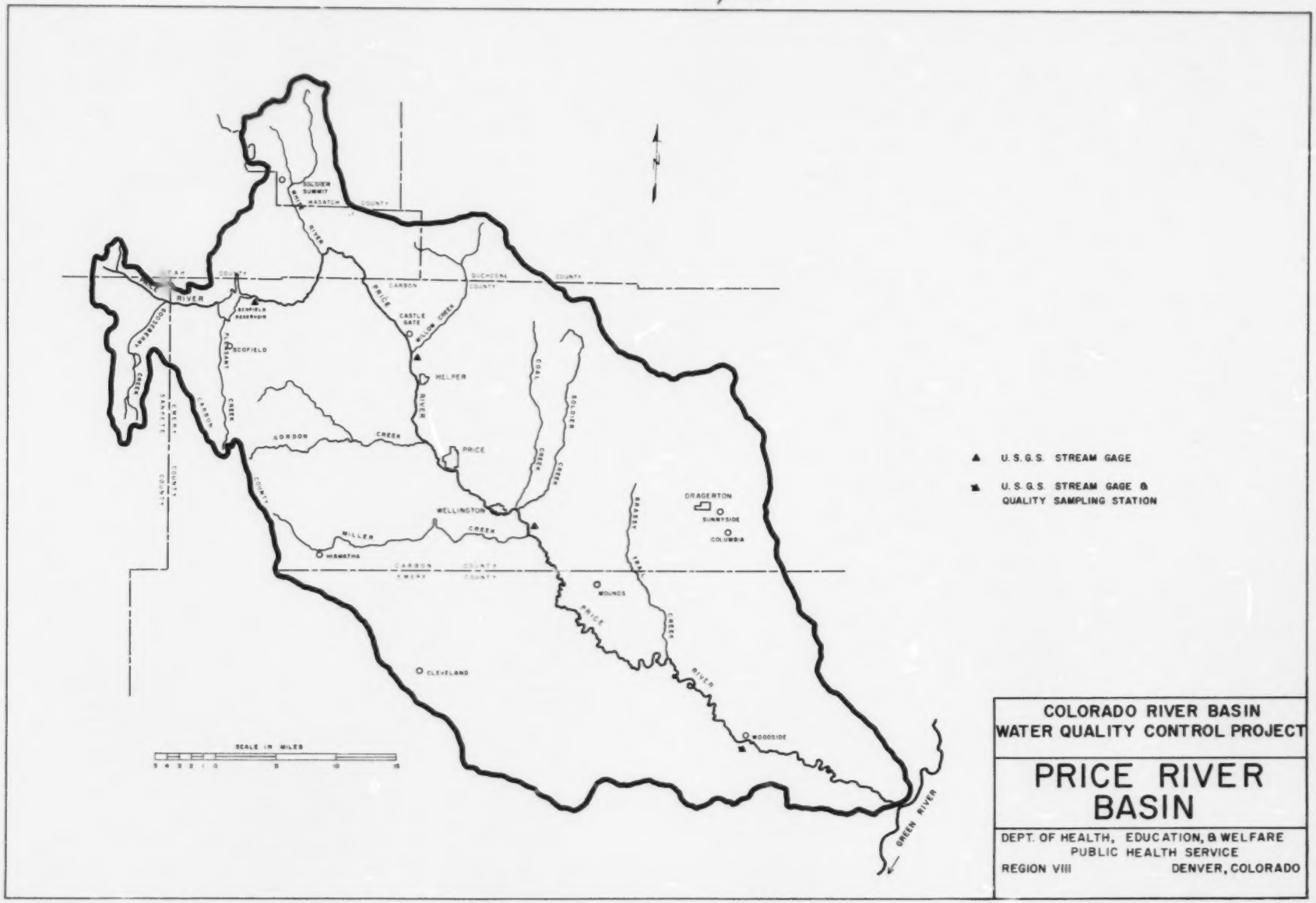

SOLDIER & SUMMIT
WASATCH COUNTY
DUCHESNE COUNTY
UTAH
COLORADO
RIVER
SCOFIELD RESERVOIR
SCOFIELD
CASTLE GATE
WILLOW CREEK
HELPER
PRICE
GORDON CREEK
WELLINGTON
MILLER CREEK
WAMSUTTA
CARBON COUNTY
EMERY COUNTY
MOUNDS
CLEVELAND
DRAGERTON
SUNNYSIDE
COLUMBIA
WOODSIDE
GREEN RIVER
SCALE IN MILES
▲ U. S. G. S. STREAM GAGE
▲ U. S. G. S. STREAM GAGE & QUALITY SAMPLING STATION
COLORADO RIVER BASIN
WATER QUALITY CONTROL PROJECT
PRICE RIVER BASIN
DEPT. OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION VIII
DENVER, COLORADO

FIGURE 1

Excellent transportation facilities have been developed in the Price area. Major transcontinental highway and rail systems traverse Carbon and Emery Counties. Two major pipelines for petroleum products have recently been put into operation. In addition, airport facilities are located at Price, Utah.

PRESENT ENVIRONMENT AND ITS HISTORICAL DEVELOPMENT

INTRODUCTION

The determination of probable future water requirements and quality considerations requires not only an understanding of the present situation in the study area but also a recognition of how the present situation came into being. This section, therefore, provides information of the past and present economic base of the study area, its historical hydrologic pattern, evolutional changes in the pattern of water use and waste treatment, as well as information on stream quality conditions.

THE ECONOMIC BASE

The resource base of any geographic area contains a number of diverse components which vary in relative importance over time. The following economic evaluation attempts to pinpoint those activities which now have a major impact on the quantity and quality aspects of the area's water supply. In addition, trend data is provided in order to place the current situation into perspective. Data are provided on a number of factors including the area's population and labor force, major basic industries, commercial activity, and an estimate of the area's developable natural resources.

IDENTIFICATION OF THE STUDY AREA FOR ECONOMIC ANALYSIS

Access to economic trend data requires identification of the study area along political subdivision lines. The geographic boundaries of the Price River Basin include portions of six Utah counties; Carbon, Emery, Duchesne, Sanpete, Utah, and Wasatch. Most of the past and present economic activity of this drainage area has centered in Carbon County. Furthermore, there appears to be a basis for assuming that this county will remain the major area of economic development in the future. For these reasons, the economic evaluation was carried on within the political boundaries of Carbon County. These data in turn were used to represent the overall economy of the geographic extent of the Price River Basin.

LAND USE AND OWNERSHIP

Irrigated crop production is limited primarily to a large area south of Price and around Wellington. The private range land is used primarily for livestock grazing unless specifically allocated for mining or other purposes.

Approximately 35 percent of the drainage area is in private ownership, Federal lands account for 57.3 percent, and the remainder, approximately 7 percent, is in state ownership. Over 90 percent of the land in private ownership is included in farms; most of the remainder is used for mining. In addition to mineral lands in private ownership, 465,730 acres of Federal land are withdrawn for mineral production (present and potential) and over 100,000 acres of state land are earmarked for present and future mineral development. National Forest lands comprise 4.7 percent of the total land in Federal ownership.

RESOURCE UTILIZATION IN THE LOCAL ECONOMY[1/]

Carbon County has three important basic industries, minerals (mining and primary processing), agriculture, and recreation, (including the impact of nontourist travelers). Manufacturing, while making a minor contribution to basic income generation in the past, has been increasing in importance during recent years.

Population Characteristics

The population of Carbon County increased steadily from 1900 to 1950, followed by a substantial decline from 1950 to 1960, as shown in Table I, Population Distribution, 1940-1960.

Table I. Population Distribution by Census Enumeration Units, Carbon County, Utah, 1940 - 1960. [2/]

Enumeration Unit and Sub-divisions	1940	1950	1960
Helper Division			
Castle Gate Town	851	701	321
Helper City	2,843	2,850	2,459
All Other Rural	3,419	2,989	2,865
Totals	7,113	6,540	5,645
Price Division			
Hiawatha Town	858	1,421	439
Price City	5,214	6,010	6,802
Wellington City	674	845	1,066
All Other Rural	3,098	3,859	1,784
Totals	9,844	12,135	10,091
Scofield Division			
Scofield Town	259	236	158
All Other Rural	349	244	123
Totals	608	480	281
Sunnyside Division			
Sunnyside Town	424	1,881	1,740
Dragerton Town	0	3,453	2,959
All Other Rural	470	412	419
Totals	894	5,746	5,118
County Totals	18,459	24,901	21,135

1/ A detailed discussion of the area's resource base is in "Preliminary Report on Water Quality and Use Aspects of the Price River Basin, (unpublished), November, 1962.

2/ Refer to U. S. Department of Commerce, Bureau of Census, United States Census of Population: Utah, 1960, "Number of Inhabitants", PC(1), 46A page 46-4, for a map of the census enumeration units listed.

The population loss during the 1950-1960 period resulted from a large net emigration of 8,635 persons.

Table II compares various population and labor force characteristics in the study area with the State of Utah.

Although the number of urban and rural nonfarm residents increased from 1940 to 1950 in the study area, both groups declined from 1950 to 1960. The greatest decline occurred in the rural nonfarm group. The farm population declined steadily during the 20-year period, dropping from 2,059 in 1940 to 1,236 in 1950 and to 648 in 1960.

The median family income in Carbon County rose from $3,499 in 1950 to $5,462 in 1960 as compared to a rise of $3,001 in 1950 to $5,899 in 1960 for the State of Utah (Table II).

Labor Force Characteristics

Carbon County has experienced a declining labor force and an unusually high unemployment rate during the past ten years (Table III). The 9.4 percent unemployment rate in 1960 was slightly higher than that in 1961 when it dropped to 8.8 percent. 1/

The gravity of the unemployment situation during the past decade resulted in Carbon and Emery Counties being designated the first area in Utah to qualify under the Federal Redevelopment Act 2/.

During 1960, over a third of the employed labor force (34.7 percent) was engaged in mining, compared to almost half of the labor force in 1950 and 39.4 percent in 1940 (Table III). Agricultural employment has been dropping rapidly, while manufacturing employment rose to 2.9 percent in 1960. Employment in retail trade and services declined percentagewise from 1940 to 1950 but then experienced a large increase to 1960.

Minerals - Mining and Primary Processing

Mineral production in Carbon County has averaged approximately $24 million in value annually during recent years. About 90 percent of this total was accounted for by coal production. Most of the remaining 10 percent was accounted for by the production of natural gas. Other minerals produced in limited amounts include carbon dioxide, helium, bituminous sandstone, sand and gravel, and various nonmetallic minerals.

1/ Unpublished data supplied by Mr. John C. Forrester, Manager, Price Office of the Utah Department of Employment Security, personal interview July 18, 1962.

2/ O.L. Harline, "Carbon-Emery Counties, A Critical Utah Unemployment Area with Long-Term Growth Prospects," Utah Economic and Business Review, Vol. 21, No. 12, University of Utah, Salt Lake City, Utah, December 1961.

Table II. Population and Labor Force Characteristics, Carbon County, Utah and the State of Utah, 1940-1960

Item	Carbon County, Utah			State of Utah		
	1940	1950	1960	1940	1950	1960
Total Population						
Number	18,459	24,901	21,135	550,310	688,862	890,627
Percent	100.0	100.0	100.0	100.0	100.0	100.0
Rural Farm						
Number	2,059	1,236	648	94,352	80,620	43,411
Percent	11.1	5.0	3.1	17.1	11.7	4.9
Rural Non-Farm						
Number	8,343	11,352	10,726	150,465	158,387	180,058
Percent	45.2	45.6	50.7	27.3	23.0	20.2
Urban						
Number	8,057	12,313	9,761	305,493	449,855	667,158
Percent	43.7	49.4	46.2	55.6	65.3	74.9
Total Civilian Labor Force	6,148	8,232	6,975	181,244	241,487	315,198
Employed						
Number	5,172[1/]	7,827	6,317	148,386	228,822	302,147
Percent of Labor Force	84.1	95.1	90.6	81.9	94.8	95.9
Unemployed						
Number	976	405	658	32,858	12,665	13,051
Percent of Labor Force	15.9	4.9	9.4	18.1	5.2	4.1
Population/Labor Force Ratio	3.00/1	3.02/1	3.03/1	3.04/1	2.85/1	2.83/1
Median Income per Family		$3,499	$5,462	Not given	$3,001	$5,899

Source: U. S. Census of Population

1/ Includes 446 persons engaged in the emergency public works program.

Table III. Total Civilian Labor Force, by Major Industry Categories, Carbon County, Utah, 1940 - 1960

Classification	1940		1950		1960	
	Number	Percent 1/	Number	Percent 1/	Number	Percent 1/
Agriculture	476	9.9	314	4.0	216	3.4
Mining	1,860	39.4	3,869	49.4	2,189	34.7
Construction	159	3.4	234	3.0	296	4.7
Manufacturing	86	1.7	195	2.4	181	2.9
Transportation	408	8.7	569	7.2	390	6.2
Communication-Utilities	63	1.4	105	1.4	142	2.3
Wholesale Trade	71	1.5	107	1.4	168	2.7
Retail Trade	673	14.2	983	12.6	1,122	17.7
Finance, Real Estate, Insurance	49	1.0	78	1.0	108	1.7
Services	698	14.7	1,052	13.4	1,254	19.7
Public Administration	154	3.3	201	2.6	193	3.1
Industry not reported	38	0.8	120	1.6	58	0.9
Total Employed	4,726	100.0	7,827	100.0	6,317	100.0
Total Unemployed	1,422	23.1 2/	405	4.9 2/	658	9.4 2/
Total Civilian Labor Force	6,148	**	8,232	**	6,975	**

1/ Percent of total employed
2/ Percent of total labor force
Source: Material provided by Bureau of Economic and Business Research, University of Utah

Carbon County produced 3,697,964 tons of coal during 1960; this amounted to 74.6 percent of total Utah production. The study area contains the largest contiguous area of coal reserves west of the Mississippi River[1/].

Agriculture and Forestry

Agricultural activity in Carbon County dates from the period of initial settlement during the 1870's. Livestock continues as the major farm enterprise with irrigated crop production in support of livestock of secondary importance. Income from the sale of farm products is currently running at about 1.5 million dollars annually. Both the number of farms and farm workers have declined substantially in recent years while the total value of farm production continued to increase.

Without irrigation, there would be no crop production in the study area except in isolated stretches along the main stream where some natural sub-irrigation occurs. Total irrigable area for service in this project amounts to approximately 16,000 acres but not all of this acreage is under irrigation because of normal irrigation rotation practices and as a result of limited water supplies in extremely dry years[2/]. An average of approximately 13,500 acres of irrigated cropland and pasture was harvested annually during the 1956-1960 period[3/]. Water diverted for irrigation use on these lands in 1960 totaled 39,918 acre-feet, which amounted to a gross diversion of 3.7 acre-feet per acre[4/]. During 1961, however, when supplies were severely restricted, only 15,496 acre-feet were diverted and 8,618 acres were irrigated[5/].

Total annual irrigation diversions during the period 1942 through 1960[6/] for all lands including the Scofield Project, from the town of

---

1/ Carbon-Emery Industrial Development Bureau, A Provisional Summary, Overall Economic Development Program for the Carbon-Emery Counties Redevelopment Area of Utah, (prepared for the Area Redevelopment Administration, U. S. Department of Commerce), Price, Utah, 1961, p. 4

2/ Statistical Appendix to Crop Report and Related Data, (Annual Reports) Federal Reclamation Projects, Bureau of Reclamation, U. S. Dept. of Interior, Washington, D. C., 1950 through 1960.

3/ Ibid

4/ Price River System, Water Distribution Report, prepared by Mr. Harvey Thomas, Water Commissioner, Price, Utah, 1960 and 1961. This total excludes 2,259 acre-feet diverted for irrigation from Gordon Creek, Grassy Trail Creek, and Milner diversion which are not considered a part of the Scofield Project.

5/ Ibid

6/ Information provided by letter dated September 14, 1962 from Mr. J. A. Libby, State Conservationist, Soil Conservation Service, Salt Lake City, Utah to the Senior Project Economist, Colorado River Basin Project, Public Health Service, Denver, Colorado.

Royal downstream and including the Carbon Irrigation Canal, ranged from 38,740 acre-feet to 78,850 acre-feet. Average annual seasonal diversion amounted to 60,240 acre-feet for this 19-year period of record. Water diverted into all canals before April and after October was not included in these tabulations as they represent only a relatively small percentage of total irrigation water use. Based on an estimated average of 13,200 acres under irrigation during the 19-year period of record, annual diversions averaged 4.6 acre-feet per acre.

A number of local ranchers are dependent upon National Forest and other public lands for supplemental grazing privileges during the summer months. During 1960, for example, the portion of the Manti-LaSal National Forest in the study area provided grazing for 25,073 sheep, for a total of 75,219 sheep months, and 370 cattle, for a total of 1,355 cow months 1/. The National Forest normally provides sawlogs for local sawmills. There is only one timber contract involving a cut of 100,000 board feet of aspen, in force at the present time but a number of larger contracts have been in effect in recent years.

Outdoor Recreation

The Price River watershed is well endowed with two elements essential for outdoor recreation - open space and scenic terrain. Most of the area falls within a desert scenery category and includes some excellent examples of the famed "canyonlands" topography of the type currently being considered for a new national park in southeastern Utah 2/. Much of the mountainous area is heavily utilized for hunting and fishing. An estimated 12,225 recreation visits were made to the Manti-LaSal National Forest portion of the Price River Drainage Basin and an additional 101,964 visitor days were accumulated at Scofield Reservoir during 1961 3/.

1/ Estimates provided by Mr. Adrian E. Dalton, Forest Supervisor, Manti-LaSal National Forest in a letter to Mr. G. G. Collins, Colorado River Basin Project, dated July 30, 1962.

2/ The proposed Canyonlands National Park will have a direct impact on the tourist-oriented segments of the local economy in Carbon County. For an economic evaluation of the proposed park refer to: R. R. Edminister, et al, An Economic Study of the Proposed Canyonlands National Park and Related Recreation Resources, (prepared for the National Park Service, U. S. Dept. of Interior), Bureau of Economic and Business Research, College of Business, University of Utah, Salt Lake City, Utah, March 1962.

3/ Estimates provided by the Forest Supervisor, Manti-LaSal National Forest, U. S. Dept. of Agriculture, July 1962, and the Bureau of Reclamation, Scofield Reservoir Reclamation Recreational Area, U. S. Department of Interior, 1958 to 1961.

Tourist and other travelers moving through the study area on U.S. Highway 6-50 and other major transportation routes have a major impact on the local economy even though many of them do not specifically visit any of the local tourist attractions.

The impact of recreational activity on the local economy is reflected primarily in the retail trade and services sectors through direct expenditures as well as providing additional employment.

Manufacturing

Employment in manufacturing has changed only slightly during the last two decades. Less than three percent of the labor force was employed in this sector of the economy, and only 14 firms were reported in operation during 1960 1/. These consisted of six food processing plants, two lumber yards, one printing and publishing company, one fabricated metals operation, one machine shop and three firms dealing in concrete products.

Commercial and Government Activities

The retail trade and services sectors are important to the local economy. Estimated sales by these two categories totaled $14,130,440 in 1961 2/. Foremost among other commercial activities are transportation and utilities. Also, a number of Federal and State government agencies maintain offices in Price. Total government employment in the county represented approximately 3 percent of the labor force in 1960.

The largest employer within the transportation sector at the present time is the Denver & Rio Grande Western Railroad. The city of Helper is a division point for the mainline of this rail system and serves also as the center of daily local freight service. The Utah Railway Company operates a freight line between Provo and the coal fields in Carbon and Emery Counties.

The Utah Power and Electric Company serves the area with a complete system of electrical transmission lines.

Current economic activity subject to sales tax collection, in Carbon County, compared with the State of Utah, is shown in Table IV. Since these data are based on Utah sales tax collection information, they do not include all economic transactions taking place. Nonetheless, they give some idea of the order of magnitude of the various sectors of the local economy compared to the State averages. The local situation differs from

1/ 1960 Directory of Manufacturers for the Colorado River Basin, Basic Data Report No. 2, Colorado River Basin Water Quality Control Project, Public Health Service, Region VIII, DHEW, Denver, Colorado, January 1962.

2/ Estimate based on retail sales tax collections data provided by the State Tax Commission of Utah, Salt Lake City, Utah.

the overall Utah picture in two important aspects - much greater dependence on mining and considerably less activity in manufacturing. Activity in retail trades and services, which partly reflect the impact of recreation on the local area's economy, are slightly higher than the state average.

Table IV. Comparison of Economic Activity in Carbon County and the State of Utah during 1961.

Type of Activity	Carbon County Est. Sales 1/	Percent	State of Utah Est. Sales 1/	Percent
Agriculture, Forestry and Fisheries	$ 1,754	2/	$ 877,202	.1
Mining	918,520	5.1	17,038,675	1.4
Contract Construction	34,400	.2	23,049,236	1.9
Manufacturing	506,160	2.8	39,849,260	7.1
Finance, Ins., etc.	28,200	.2	713,703	.1
Transportation, Communication & Utilities	1,231,600	6.9	90,622,157	7.3
Wholesale Trade	1,041,960	5.8	95,266,695	7.7
Retail Trade	12,745,560	71.0	336,555,604	67.2
Services	1,434,880	8.0	90,237,449	7.2
Totals	$17,943,034	100.0	$1,244,264,986	100.0

1/ Estimated sales based on the Utah sales tax collections, January 1, 1961 through December 31, 1961. Does not reflect total sales, especially in some sectors such as agriculture and mining.

2/ Less than .01 of one percent.

Source: State Tax Commission of Utah, Schedule of Sales and Use Tax Collections, Industrial Classifications by County, Salt Lake City, Utah, 1961.

HYDROLOGY

Extreme variations in stream flow have been recorded in the Price River drainage system during the period of available records. A numerical comparison of yearly flow data for the 1946 - 1961 period is shown in Table V. The minimum flow on record near Heiner was less than 1 cubic foot per second during September 1-10, 1934. The average flow of the Price River near Heiner was 92,000 acre-feet annually and an average of 70,000 acre-feet leaves the Basin annually, flowing to the Green River. Location of the gaging stations is shown in Figure 1.

Ground water from springs near Colton, Utah is a factor in the continued support of the local economy; springs are utilized as a major source of municipal and industrial water supplies. There are only a few wells in use in the study area. Water from wells in Mancos shale areas are extremely high in salt content and are not used for domestic purposes except in cases where no alternative sources of supply are available.

Table V. Flows in the Price River, 1946-1960 (in acre feet)

Water Year	Price R. near Scofield	Price R. near Heiner	Price R. near Wellington	Price R. near Woodside
1946	36,050	53,870		
1947	33,760	64,750		51,130
1948	42,700	62,700		35,800
1949	31,500	85,500		84,100
1950	39,440	80,750	38,900	67,720
1951	44,490	72,610	25,830	60,060
1952	96,660	225,300	208,800	247,800
1953	57,660	79,900	35,850	58,850
1954	50,520	63,420	27,260	52,440
1955	36,430	59,020	22,090	44,420
1956	38,090	61,490	15,480	24,650
1957	26,710	66,150	37,800	74,360
1958	63,090	126,200	79,700	132,000
1959	46,080	50,680		32,260
1960	32,930	41,990		23,440
1961	13,760	18,340		52,950
Avg. Flow	43,116	75,794	54,634	69,465
	45,030(27 yrs)	81,080(26 yrs)		
		91,510(50 yrs)[1/]		

Source: Surface Water Supply of the United States, U. S. Geological Survey Water Supply Papers, Washington, D. C.

1/ Average yearly flow at the Heiner and Helper gaging stations is 91,510 acre-feet. This is not corrected for the station being moved. Further, the Upper Colorado River Basin Compact Commission has calculated the mean historic flow of the Price River near Heiner as 92,600 acre-feet annually (1914-1945), as stated in the Final Report Engineering Advisory Committee to Upper Colorado River Basin Compact Commission, Denver, Colorado, November 29, 1948, p. 16.

TOTAL WATER DEMAND

Table VI summarizes the present water use in the Price River Basin[1/]. This water was diverted from the Price River, its tributaries, springs, and wells. Total water demand for 1960 was estimated to be 55,000 acre-feet; approximately 80 percent of this was diverted from the Price River, 10 percent from tributaries and 10 percent from ground-water sources. The peak monthly demand usually occurs in July and August.

Municipal water use, consisting of domestic, commercial and rural uses, required 5,500 acre-feet of water in 1960. Per capita use varied from 43 gallons to 1,060 gallons daily with an average use of 225 gallons daily. Estimated average per capita use amounts to 225 gallons per day in the study area as compared to 301 gallons per capita day for the State of Utah[2/].

Industrial water use is restricted mainly to coal washing plants, coal mining operations, and one steam electric power plant. Total industrial use was estimated to be 7,500 acre-feet in 1960.

Irrigation water use in the Basin over a 19-year period (1942-1960) has ranged from 38,740 acre-feet to 78,350 acre-feet. The average water use is 60,840 acre-feet or 4.6 acre-feet per acre. This relatively high rate reflects distribution losses of approximately 30 percent and on farm efficiency of only 40 to 50 percent. The rate of irrigation use is highly dependent upon the quantity of water available. This was illustrated in 1961 when only 15,496 acre-feet for 8,618 acres were available. In 1960 the months of May, June and July were the major irrigation water demand months and accounted for approximately 75 percent of the total diversion.

Consumptive water use for the Price River Basin for all uses is estimated to range from 30 to 40 percent of the total withdrawal. Instream use of the Price River and its tributaries is limited to some fishing in the mountain reaches and recreational properties adjacent to the stream.

1/ Instream uses were not included. Diverted water uses include irrigation, municipal and industrial withdrawals from the Price River Basin. Data upon which these estimates are based include information obtained through a mailed questionnaire survey conducted by the University of Utah, interviews of water users in the area conducted by the Colorado River Basin Project staff and the following report: Price City, Utah, Report on Water Supply, Templeton & Linke, Consulting Engineers, Salt Lake City, Utah, December 1957, pp 42-48.

2/ Estimated Use of Water in the United States, 1960, Mackechan & Kammerer, USGS, C456, Washington, D. C. 1961.

Table VI. Summary of Present Water Use in the Price River Basin in East Central Utah for 1960

MUNICIPAL (Domestic, Commercial and Rural)

Area	People Served By System	Total Water Diverted to System MG per Year	Daily Per Capita Use - GPCD	Total Acre Feet
Scofield Area				
Clear Creek	96	20.0	571	
Scofield	158	----	---	
Price Area				
Royal	30	10.0	918	
Castle Gate	353	39.6	307	
Helper	2709	203.9	206	
Price	9802	778.1	221	
Wellington	1800	39.6	60	
Latuda	200	3.1	43	
Kenilworth	496	33.0	182	
Hiawatha Area				
Hiawatha	439	58.1	429	
Wattis	27	10.4	1060	
Elmo 1/	180	3.7	55	
Cleveland 1/	385	29.2	213	
Dragerton Area				
Dragerton	2265	243.4	294	
Columbia	400	57.6	394	
Sunnyside	1740	176.9	279	
TOTALS	21080	1707.6	222	
RURAL	620	77.2		
TOTAL	21700	1784.8	225	5480 Acre Feet

1/ Estimated by Colorado River Basin Project Staff.

TABLE VI. Summary of Present Water Used in the Price River Basin in East Central Utah for 1960 (Continued)

INDUSTRIAL (estimated)

Industry Group	% of Firms Reporting	Total Employment	Total Water Use MG Per Year	Adjusted Water Use Per Employee	Total
Mining	93.5	1,889	1,389.7	735.7	
Manufacturing	39.1	128	149.5	1,168.0	
Durable Goods					
Furniture, Lumber and Wool	0	12	0.3	24.1	
Fabricated Metals	0	4	0.2	43.1	
Machinery	85.0	20	7.9	398.9	
Other	100.0	17	2.0	119.5	
Non-Durable Goods					
Food & Kindred Products	27.1	59	56.2	952.0	
Textile Mill Prod.	0	4	0.1	24.4	
Chemical and Allied Products	0	12	82.8	6,897.3	
Utilities	100.0	62	904.0	14,580.8	
Total	90.4	2079	2,443.2	1,175.2	7500 AF
TOTAL M & I			4,228.0	535gpcd	12,980
AGRICULTURE IRRIGATION					42,177
BASIN TOTAL					55,157

Source: Compiled by the Bureau of Economic and Business Research, University of Utah.

POLLUTION SOURCES

Deterioration of the water quality in the Price River Basin occurs not only from man-induced uses but also from natural causes such as land drainage. While municipal wastes and most industrial wastes can be treated by present methods, the pollution resulting from natural causes is generally much more difficult to treat. Pollution from natural causes is primarily in the form of increased chemical constituents and sediments. A discussion of the various pollution sources follows.

MUNICIPAL

Pollution of instream waters from municipal wastes is currently a problem in the Price River Basin. Although many individuals and a few of the municipalities have septic tank treatment systems, there is considerable discharge of raw sewage to the Price River and tributaries from major population centers. Table VII illustrates present waste treatment and effluent discharge practices in the Price River Basin.

Only Sunnyside has secondary sewage treatment (Table VII). The major organic pollution in the Price River comes from the cities of Helper, Price, and Wellington which have a total of six sewer outfalls discharging into the river. During the low flow months of winter and late summer (when irrigation diversion is at a peak), this sewage discharge makes up a large portion of the flow in the Price River from Price to Wellington. The municipal sewage results in high coliforms and high biochemical oxygen demand.

The Hiawatha, Cleveland, Scofield, and Dragerton areas do not at present contribute significantly to the pollution of the Price River since wastes are either treated or as yet are of insufficient volume to cause significant contributions to existing stream pollution.

A plan is now under consideration that proposes to link together all the municipalities and suburbs from Castle Gate to Wellington into a single sanitary district. A secondary sewage treatment plant below Wellington would treat the combined sewage and discharge the treated wastes to the Price River.

INDUSTRIAL

No major industrial wastes are discharged to the river in the Price area. All commercial activities, including creameries and slaughter houses are included in the municipal sewage outfalls and there are no known analyses of these raw sewage effluents available. The Utah Power and Light Company releases blow-down water from their cooling process to Willow Creek, and has no apparent effect on downstream water users at present. The Wellington coal washing plant uses lagoons for its wastes. There is a possibility that coal dust, from the numerous coal piles in the Castle Gate area, will be deposited in the water.

Table VII. Waste Sources in the Price River Basin

Municipality or Industry	1960 Population or Employees Served	Treatment Provided	Est. Waste Discharge MGD	Est. Waste Discharge PE's	Drainage to
Scofield Area					
Clear Creek	96	Septic Tank		70	Mud Creek
Scofield	158	Individual	---	--	Mud Creek
Price Area					
Royal	75	Septic Tank		50	Price River
Castle Gate	150	Septic Tank	None	--	Subsurface Appl'n
Independent Coal & Coke	30	None	None	--	Subsurface Tile Field
Utah Light & Power		None	0.7 a/	--	Willow Creek
Helper	3000	None (Sewered)		3000	Price River
Price	7000	None (Sewered)		7000	Price River
Wellington	850 b/	None (Sewered)		700	Price River
Knight Ideal Coal Company	---	----			Price River
U.S. Steel Coal Washing Plant	44	Lagoons	None	--	Price River
Hiawatha Area					
Hiawatha	439	Septic Tank	.05E	300	Miller Creek
Wattis	27	Septic Tank		20	Serviceberry Cr.,Miller Creek
U.S. Fuel Company	--	Slurry Pond	None	--	
Elmo	180	Individual	----	--	Desert Seep Wash
Cleveland	385	Individual	----	--	Desert Seep Wash
Dragerton c/					
Dragerton	2959	Intermediate	0.386	1500	Icelander Cr., Grassy Trail Creek
Columbia	400	Imhoff Tank	0.05E	280	Dry Ditch
Sunnyside	1740	Secondary	0.789	250	To controlled Pasture, Icelander Creek, Grassy Trail

a/ 1/3 of water used is discharged as blow-down water (hard).
b/ 188 sewer connections - 46 houses with own facilities.
c/ Water is seldom discharged from the mines.

IRRIGATION

Pollution also results from the use of Price River water for irrigation. The irrigation water leaches salts from the soil and these salts are contained in the drainages returned to the stream. The return flows are highest in June, July and part of August, but the greater problem will occur when the natural flows are low in the receiving streams (August and September) causing the concentrations to increase to a greater degree.

NATURAL

Natural runoff causing an increase in inorganic salts is a major contributor of salts in the Price River Basin, but its share of the contribution is difficult to separate from that supplied by irrigation. During flash floods, heavy loads of sediment are carried in suspension from erosion on the steep slopes adjacent to the stream.

WATER QUALITY

The Price River and its tributaries above Castle Gate are typical mountain streams, relatively free from mineral constituents and municipal and industrial pollution. Between Castle Gate and Helper coliform organisms increase moderately while the mineral constituents are relatively unchanged. From Helper to Woodside the river is seriously polluted from municipal wastes and the mineral constituents from natural runoff and agricultural drainages make the water unsatisfactory for most uses.

The geologic strata that make up the exposed surface of the Price River area are conducive to erosion by surface runoff and to leaching by waters which permeate below the surface and return to the stream system at some lower-lying point. These waters readily carry a sediment load and dissolved salts to the stream system in accord with the type of geologic strata and derived soils with which the waters have been in contact.

SURFACE WATERS

Large quantities of water quality data for the Price River system have been accumulated since 1946 1/. Numerous samples have been collected by several different agencies. In addition, a limited number of stream samples were collected by the U. S. Public Health Service in July 1962. The results of the Public Health Service analyses are presented in Table VIII. These agree basically with the aforementioned published data. The significance of current water quality in relation to various uses is discussed below.

1/ Utah State Dept. of Health, Chemical Analyses on Municipal Water Supplies of Utah, Salt Lake City, Utah, 1953. A.R. Gaufin, Limnological Analyses of Jordon, Price, Provo, and Weber Rivers, and Report on Limnological and Sanitary Characteristics of Jordan, Price, Provo, and Weber Rivers for 1957-1958, University of Utah. J. A. Ward and C. M. Skonbye, Flow Characteristics and Chemical Quality of the Waters of a Section of Price River, Carbon County, Utah for the Years 1957 and 1958, Utah State Water Pollution Control Board. Office of the Utah State Engineer, A Compilation of Chemical Quality Data for Ground and Surface Waters in Utah, Tech. Pub. No. 10, 1958. USGS Quality of Surface Waters of the United States, Selected issues of the Water-Supply Papers, U. S. Government Printing Office, Washington, D. C.

Table VIII. Chemical Analyses of Streams

Map #	Location	Date	Time	Est. Flow cfs	Ca ppm	Mg ppm	Na ppm	K ppm	Fe ppm	HCO_3 ppm	SO_4 ppm	Cl ppm	Hardness as $CaCO_3$ ppm	Dis. Solids ppm	Spec. Cond. mhos 25°C	pH	Dis. Oxygen ppm	Field Temp. °C
1	Price R. below Scofield Res.	7/17/62	1035	220E	57	12	2	1.0		218	20	4	193	208	365	7.9		19
2	White R. near Soldier Summit	7/17/62	1135	2E	61	29	23	1.2		354	30	5	270	336	570	8.0		15
3	Price R. near Colton	7/17/62	1225	250E	52	15	4	1.2		222	19	4	190	209	350	8.0		20
4	Price R. near Royal	7/17/62	1310	250E	42	20	5	1.0	0.02	215	21	4	186	203	370	7.9		20
5	Willow Creek below Forks	7/17/62	1345	5E	39	38	85	2.3	0.01	298	165	10	254	419	707	8.1		24
6	Price R. below diversion	7/19/62	0540	4E	57	31	17	1.7		266	90	8	270	380	631	7.9		14
7	Price R. near Maxwell	7/17/62	1455	10E	153	68	176	5.9		300	738	36	664	1690	2070	7.8	6.5[a/]	26
8	Price River above Wellington	7/17/62	1545	25E	188	134	292	6.0		299	1300	38	1020	2320	2730	7.8	4.5[b/]	26
9	Price R. below Wellington	7/19/62	0630	50E	203	135	298	6.9		355	1310	40	1060	2380	2780	7.9	5.5	15
10	Miller Cr. near Wellington	7/17/62	1610	10E	214	197	492	8.8		306	2010	82	1350	3490	3990	7.8		27
11	Price R. near Mounds	7/17/62	1720	75E	200	164	379	6.9		327	1630	53	1170	2850	3280	7.9		26
12	Price R. at Woodside	7/17/62	1825	75E	233	210	528	8.8		265	2210	77	1450	3840	4240	8.0		25

a/ Dissolved oxygen sample taken on 7/19/62 at 0520. Temperature 13°C.
b/ Dissolved oxygen sample taken on 7/19/62 at 0605. Temperature 15°C.

Figure 2 relates the locations of US PHS sampling points shown in Table VIII. These sampling points were selected to indicate the deterioration of the river as it travels downstream. Only one sample was taken at each point and while this can't be considered representative, the results shown do agree substantially for that time of year with the other results published. The confluence of Gordon Creek with the Price River serves as a separation point in water quality since during the summer irrigation period practically all the water is diverted upstream of the diversion dam and Gordon Creek is the first major inflow after these diversions.

IRRIGATION

Irrigation use of water from the Price River below its confluence with Gordon Creek is limited to the growing of salt-resistant crops. Note, for example, that total dissolved solids, particularly sulfates, are high. Sodium percentages as related to total of calcium, magnesium and sodium are under 60, due to the presence of large calcium and magnesium concentrations. Values above 60 are generally considered unfit for use in most cases.

In irrigated areas, excessive water application tends to cause erosion of the tilled areas, adding a moderate amount of suspended solids to the streamflow. Also, with the leaching of the soils of these areas and with evapo-transpiration, the concentration of dissolved salts in the irrigation return waters is high. (See Table VIII, #10, Miller Creek).

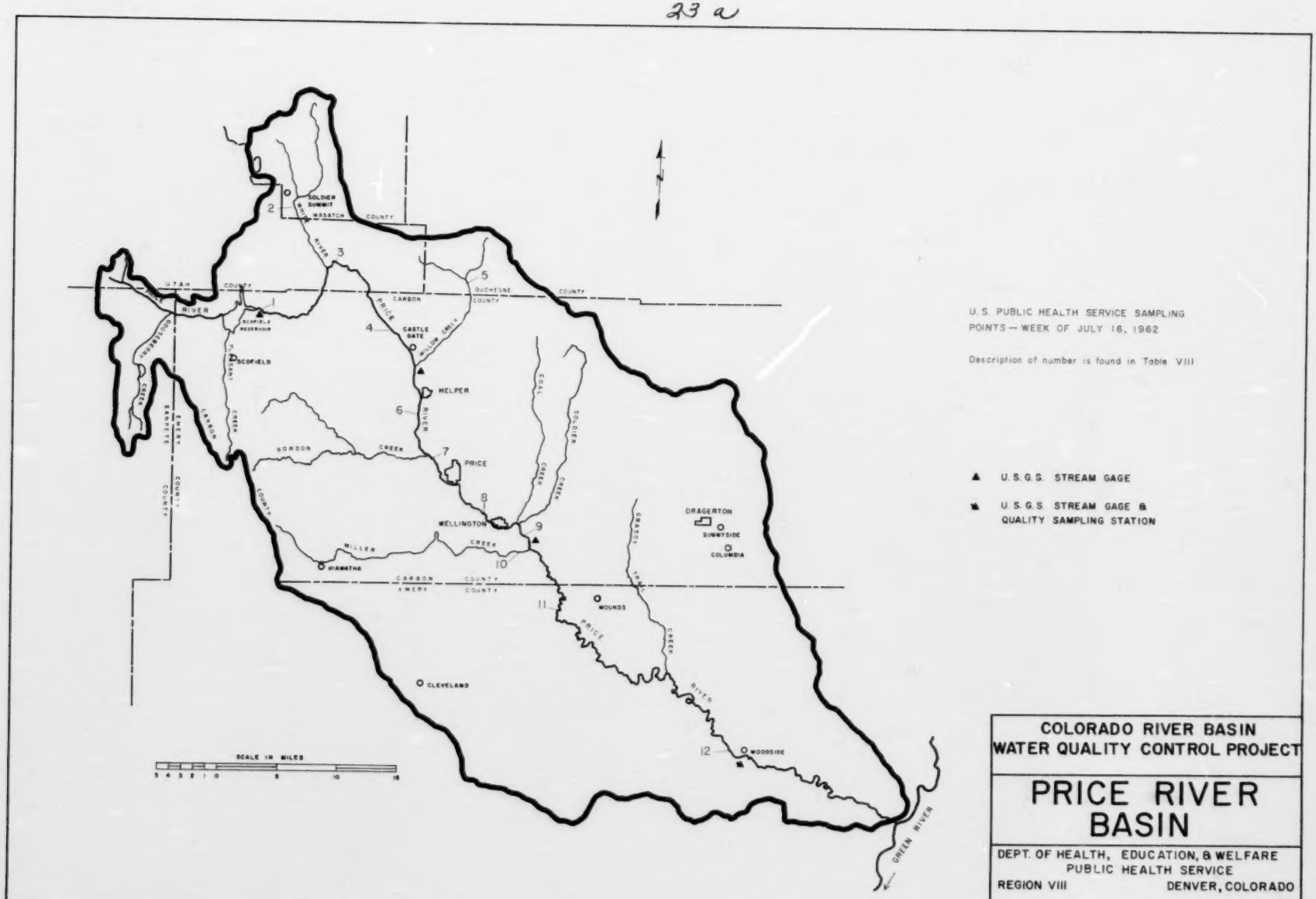
MUNICIPAL

The water above Helper is satisfactory for municipal use when compared to the PHS Drinking Water Standards[1]; sulfates are less than 50 mg/l; chlorides are less than 10 mg/l; and nitrates are present in low concentrations. The water is hard, however, as hardness ranges from 175 to 300 mg/l.

Below the confluence of Gordon Creek and the Price River, the water is unsuitable for municipal use. The total dissolved solids values range from 1,690 to 4,000 mg/l (500 limit is recommended by Public Health Service)[2] and total hardness ranges from 500 to 2500 mg/l. Hardness in itself would require expensive treatment before domestic use. In view of the high sulfate and magnesium concentrations, a pronounced laxative effect on domestic users could result.

1/ Department of Health, Education and Welfare, Public Health Service, Interstate Quarantine Drinking Water Standards, Washington, D. C., approved February 28, 1962.

2/ Ibid.



U. S. PUBLIC HEALTH SERVICE SAMPLING POINTS — WEEK OF JULY 16, 1962

Description of number is found in Table VIII

▲ U. S. G. S. STREAM GAGE

▲ U. S. G. S. STREAM GAGE & QUALITY SAMPLING STATION

COLORADO RIVER BASIN
WATER QUALITY CONTROL PROJECT

PRICE RIVER BASIN

DEPT. OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION VIII DENVER, COLORADO

FIGURE 2

INDUSTRIAL

The waters throughout the Price River Basin are generally suitable for gross industrial uses, such as coal washing and cooling. Treatment of water taken above Helper may be necessary for use in food-related industries, boiler use, and other uses demanding higher quality. The quality of the water below the confluence of Gordon Creek and Price River is generally unsuitable for industrial uses requiring good quality water. Since known methods of treatment to reduce minerals are presently prohibitively expensive, this places a severe limit on the use of this water for these purposes.

GROUND WATER

The largest use of ground water is by Helper and Price and in the Dragerton area. Helper and Price take water from a well and springs near Colton and the quality of this water is similar to that sampled on the Price River below Scofield Reservoir. The ground water used in the Dragerton area is of unknown quality. There are no wells in the Price area except for a well east of Wellington used by the coal washing plant.

SELECTED FUTURE ENVIRONMENTAL CONDITIONS

INTRODUCTION

The following information on future environmental conditions for the Price River Basin was developed within the assumptions prepared for the overall water quality management study of the Colorado River Basin currently underway by the U. S. Public Health Service. In addition, it is based upon an evaluation of the resource base of the study area and an estimate of the likelihood of its future development by various sectors of the local economy. One serious limitation was placed upon this analysis; data on developable water supplies were not available. The projections which follow, therefore, were developed under the assumption that all factors required in future development are favorable for those activities projected with the exception of a known water supply of suitable quality.

PROJECTION OF MOST PROBABLE ECONOMIC DEVELOPMENT, 1960 - 2060

The economic projections that follow are designed to provide an estimate of the most probable future development in the area to the year 2060. In addition, it should be pointed out that these projections were developed to form a basis for long-range planning. Short-term variations in the future growth path can be expected to occur. The probability of deviation, even from the long-term projections, increases as one moves farther into the future. As the results of more detailed economic studies of the area become available, modifications in the preliminary projections presented below may become necessary. 1/

MAJOR FACTORS INFLUENCING FUTURE ECONOMIC DEVELOPMENT

The extent of future economic development in the study area will be dependent largely upon the following factors:

1. Carbon and Emery Counties contain a significant share of the vast known coal reserves in Utah, and Utah in turn is a major supplier of coal for the Western states; any improvement in the coal producing sector of Utah's economy will have a direct impact on the economy of the study area.

1/ Results of two studies in particular may have a bearing: (a) The detailed study of the Utah economy under preparation by the Bureau of Economic and Business Research, University of Utah, at the request of the Bureau of Reclamation; and (b) the economic study of the Green River Sub-Basin, by the Associated Rocky Mountain Universities, Inc. and the Economic Research Service, U. S. Dept. of Agriculture, at the request of the Colorado River Basin Water Quality Control Project; scheduled for completion about August 31, 1963.

2. The Carbon-Emery area was the first area of substantial and persistent unemployment designated in Utah under the Federal "Area Redevelopment Act." As a result, research and promotional programs have been inaugurated to aid in: a) the establishment of additional manufacturing facilities; b) the promotion of the area as a gateway to south-eastern Utah's scenic attractions; and c) to make expanded use of the area's abundant mineral resources. The result of this activity is expected to have a direct accelerating influence on the area's future economic growth.

3. The future expansion of those sectors dependent upon tourist and other travelers - notably retail trades and services - is virtually assured. Not only does the area contain a number of notable recreational and scenic attractions, it also lies on a major cross-country transportation route. The future impact of recreation on major cities in the Price River Basin will be affected, however, by the fact that the new inter-state route will by-pass these population centers. Nonetheless, as the overall rate of travel through the area increases, so will this share of basic income produced.

4. An expected decline in the availability of low cost residual fuel oil from Salt Lake City petroleum refineries requiring conversion to other sources of power to serve that area's expanding industrial base so that expansion of coal production in the study area can be expected to fill this need in part.

5. Consideration is presently being given to the eventual construction of huge power generating complexes in the heart of the Utah coal fields in order to produce power for use in future electrochemical and electrometallurigical industries. Such an installation, if it is developed, will probably be built at Green River, Utah but nonetheless will operate on coal produced in Carbon and Emery Counties. This is of course a long-range development but is considered highly probable soon after 1990.

6. A project to construct a 600 to 650-mile pipeline for the transmission of coal slurry to the Los Angeles and San Francisco area, estimated to deliver some 6,000,000 tons a year initially, is in the preliminary planning stage. It is anticipated that this pipeline will be in operation in the early 1980's if rights to a sufficient water supply can be obtained. It is expected that the study area will provide approximately two-thirds of the coal to be delivered.

FUTURE POPULATION AND LABOR FORCE

An estimate of future population and labor force in the Price River watershed area, based on the factors listed above, is shown in Table IX. Distribution of the population, by location of residence, is shown in Table X. The agricultural industry is expected to decline in relative importance with a leveling off, in terms of number employed, by 1990. Recreational impact on the local economy, particularly in the retail trade and service categories, will likely be of major importance during the 1960-1980 period. Although the impact of recreation will continue throughout the entire projection period, the impact of increased activity in mining, particularly in coal production, and the expansion of industries, some of which will be dependent upon coal as a raw product, are expected to be the dominating sectors of the economy after 1990. The percentage of the labor force unemployed is expected to drop from the 1960 level of 9.4 percent to 5.0 percent by 1970, and to remain more or less constant at 4.0 percent after 1980.

An estimate of future population trends, by location of residence, is shown in Table X. The current urbanization trend in the county is expected to continue throughout the projection period. Urban population is expected to increase from 57.7 percent of the total population in 1960 to 84.7 percent in 2060. The percentage of non-urban residents is expected to decline throughout the projection period, although in terms of absolute numbers, an increase is expected to the year 2020 followed with a decline to 2060. The farm population component is expected to decline from 3.1 percent of the total population in 1960 to 0.4 percent of the total in 2060.

PROJECTED ECONOMIC ACTIVITY

Assumed changes of major significance which have an impact on the population and labor force projections are summarized below:

Agriculture

Both farm population and farm labor force are expected to decline during the 100-year projection period, but agricultural incomes are expected to increase consistent with trends of the past decade. The agricultural industry is expected to decline in relative importance, however, as projected expansion in manufacturing, mining, and recreational activities occur.

Potential agricultural development in the area would involve expansion of the livestock industry, improved irrigation efficiency on farms, and concentration of irrigated acreages on soils that will give good yield response. Future irrigated acreages in the Price area will be influenced largely by the following factors:

TABLE IX. SUMMARY OF POPULATION, LABOR FORCE AND EMPLOYMENT PROJECTIONS, CARBON COUNTY, UTAH, 1960-2060

	1960		1970		1980		1990		2000		2020		2060	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Total Population	21,135	-	22,800	-	28,800	-	38,600	-	48,700	-	53,500	-	64,500	-
Total Civilian Labor Force	6,975	100.0	7,535	100.0	9,550	100.0	12,860	100.0	16,250	100.0	18,354	100.0	21,830	100.0
Unemployed	658	9.4	377	5.0	385	4.0	515	4.0	650	4.0	734	4.0	870	4.0
Employed	6,317	90.6	7,158	95.0	9,165	96.0	12,345	96.0	15,600	96.0	17,620	96.0	20,960	96.0
Employment Distribution														
Agriculture	216	3.1	150	2.0	125	1.4	100	.8	100	.6	100	.5	100	.4
Mining	2,189	31.4	2,200	29.2	2,600	27.2	3,400	26.4	4,200	25.8	4,400	24.0	4,800	22.0
Manufacturing	181	2.6	411	5.5	650	6.8	1,114	8.7	1,508	9.3	1,729	9.4	2,070	9.5
Durable Goods	53	.8	120	1.6	195	2.0	280	2.2	315	1.9	350	1.9	420	1.9
Nondurable Goods	128	1.8	291	3.9	455	4.8	834	6.5	1,193	7.4	1,379	7.5	1,650	7.6
All Other Industries	3,731	53.5	4,397	58.3	5,790	60.6	7,731	60.1	9,792	60.3	11,391	62.1	13,990	64.1

Source: Preliminary population and employment projections, Bureau of Economic and Business Research, University of Utah, Salt Lake City, Utah, April 1963.

TABLE X. PROJECTED POPULATION TRENDS BY SOCIO-ECONOMIC ORIENTATION, CARBON COUNTY, UTAH 1960-2060

	1960		1970		1980		1990		2000		2020		2060	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Urban Residents	12,220	57.8	14,820	65.0	20,131	69.9	29,567	76.6	38,035	78.1	42,051	78.6	54,632	84.7
Price Area Complex[1/]	(13,600)	64.4	(15,800)	69.3	(20,800)	72.2	(28,300)	73.3	(36,100)	74.1	(39,800)	74.4	(50,100)	77.7
Non-Urban Residents	8,915	42.2	7,980	35.0	8,669	30.1	9,033	23.4	10,665	21.9	11,449	21.4	9,868	15.3
Farm	648	3.1	365	1.6	317	1.1	270	.7	292	.6	268	.5	258	.4
All Other Non-Urban	8,267	39.1	7,615	33.4	8,352	29.0	8,763	22.7	10,373	21.3	11,181	20.9	9,610	14.9
Total Population	21,135	100.0	22,800	100.0	28,800	100.0	38,600	100.0	48,700	100.0	53,500	100.0	64,500	100.0

1/ Includes Price, Wellington, Helper, Castle Gate, Royal, and surrounding areas.

1. Relative returns from using water for irrigation versus other water uses in the study area.

2. Existing water rights and their influence upon future development.

3. Availability of some water of suitable quality for irrigation use after initial use for municipal and industrial purposes upstream.

Therefore, irrigated acreage in the study area is expected to remain at about the 1956-60 average of 12,500 acres. A decline in the present irrigable area from 16,000 acres to an estimated 13,000 acres is expected largely as a result of urban and industrial encroachment. However, anticipated increases in technology, productivity, and managerial skills as well as the trend toward larger farm units are expected to offset this decline by bringing under irrigation acreages in the present system not now irrigated. These non-irrigated areas are a result of water logging, part-time or small, inefficient farm units, and the like.

Mineral Development

The projected increases in mining activity were based primarily upon the assumed need for greater quantities of coal on the Pacific Coast (to be shipped via pipeline), development of a small coal liquification industry in the area and a slight increase in steam generation activity. Char resulting from coal liquification would be used in part as fuel for increased steam electric production. Productivity increases are expected to be slightly lower than those achieved during the last decade. An overall increase of 2 to 2-1/2 times the 1960 production is anticipated by 2000. In adddtion, it is assumed that oil shale production will be initiated within the county by 1980 and expanded further by 1990.

Manufacturing

It is assumed that an apparel plant would be in operation by 1970 with moderate expansion in labor force by 1980. A coal liquification plant was assumed to be in operation by 1990. The coal liquification plant is expected to expand in size by 2000 and also by that year, an oil shale processing plant is expected to be in operation. Expectation of both a coal liquification plant and an oil shale processing plant in the area is based on an assumed increase in the world price of petroleum and continued improvements in technology for coal liquification and oil shale refining. It is expected that the distillation process will be used for coal liquification with the hydrogenation of coal producing liquid petroleum products from the volitile materials driven off with the addition of hydrogen from other sources. Char as a residual from this process can be used as fuel in space heating and other similar uses. An expansion of

selected manufacturing industries to serve non-local markets is likewise assumed. This expansion is expected to be coincident with the growth of the region's overall economic base and to be stimulated by research and development activities of the Area Redevelopment Administration program in the area.

Transportation and Utilities

It is assumed that a coal slurry pipeline to the Pacific Coast will be in operation by 1990. Some expansion in the steam electric power plant capacity now located in the area is expected by 1980. Construction of a link of the interstate highway system will be completed by 1970.

Tourist Oriented Industries

Initial expansions in retail trades and services is expected as a result of increased recreational activity and through traveler impact to 1980. After 1980, these sectors are expected to increase in part from the anticipated increase in activity in the mining and manufacturing sectors.

PROJECTED WATER USE

The future demand for water in the Price River Basin will be largely influenced by the following factors:

1. Requirements for water as affected by climate in semiarid areas.

2. Increases in population and economic activity projected for the study area.

3. Expected changes in water costs, availability, and extent of metering.

4. An increasing consumer awareness and demand for higher quality water.

5. Continued increases in water utilization efficiency, particularly in irrigation and industrial processes.

BASIC ASSUMPTIONS

The future water demand figures were developed under the following assumptions:

1. The timely availability of water of suitable quality to support the projected demands without being a constraint.

2. Future economic development will take place primarily in the Price River Valley from Royal to Wellington and in the Dragerton area.

3. All future major water diversions from the Price River will be made above Helper.

4. The demand figures calculated are on a one-use basis and do not include possibilities of reuse of the same water.

5. Future municipal and industrial demands for water in the Dragerton and Hiawatha area will not be dependent upon supplies from the Price River system but nonetheless their requirements are included in the total aggregated water demand projections.

6. Continued increases in on-farm irrigation efficiency and reduction of losses during distribution will develop.

PROJECTED WATER REQUIREMENTS

Table XI shows the projected aggregate demand for municipal, industrial and irrigation water in the Price River Basin and Table XII shows the same for that area using the Price River as a source of supply. Maximum monthly demand as shown in Table XI was calculated to illustrate what may be expected for the peak month in the selected years and ranges from 125 MGD to 222 MGD.

The overall average demand ranges from 55,000 acre-feet in 1960 to 120,000 acre-feet per year in 2060.

In-Stream Uses

No significant increase in recreational uses of in-stream waters is anticipated in the future but a continuing pressure on facilities at Scofield Reservoir and other potential water storage structures in the study area can be anticipated.

Municipal

Projected municipal water use on a per capita basis is expected to increase from 225 in 1960 to 300 gallons per capita day in 2060. Tables XI and XII show these projected increases for the various years and it is assumed that the rural population uses the same per capita amount as those living in the towns. A greater increase than that projected is not anticipated since efficiency in the use of water is expected to reduce the present trend in requirements for specific uses (lawn watering) which in turn have been primarily responsible for a rising trend in per capita use in the past. Municipal use for the basin is expected to increase from 5 MGD in 1960 to a projected 19 MGD in 2060.

TABLE XI. PROJECTED AGGREGATE WATER DEMAND BY MAJOR WATER USE CATEGORIES, PRICE RIVER BASIN, 1960-2060

Description	1960	1970	1980	1990	2000	2020	2060
Municipal Use							
Basin Population	21,700	22,800	28,800	38,600	48,700	53,500	64,500
Per Capita Use	225	240	250	260	270	280	300
Water Use in MGD	4.8	6	7	10	13	15	19
Industrial Use[1]							
Industrial Labor Force	2,370	2,611	3,250	4,514	5,708	6,129	6,870
Water Use in MGD	6.7	10	15	25	37	40	43
Total M&I Yearly Demand - Acre-feet/year	12,980	13,800	24,700	39,000	56,000	62,200	70,000
Irrigation[2]							
Acres Irrigated	12,500	12,500	12,500	12,500	12,500	12,500	12,500
AF/acre	3.4	4.2	4.0	4.0	4.0	4.0	4.0
Water used in Acre-feet/year	42,177	52,500	50,000	50,000	50,000	50,000	50,000
Total Yearly Demand - Acre-feet/year	55,157	66,300	74,700	89,000	106,000	112,200	120,000
Consumption in Acre-feet at 35%	19,000	23,000	26,000	31,000	37,000	39,000	42,000
Maximum Monthly Demand							
Municipal in MGD [3]	7	9	11	15	20	24	29
Industrial in MGD	7	10	15	25	37	40	43
Irrigation in MGD [4]	111	160	150	150	150	150	150
Total in MGD	125	179	176	190	207	214	222

1/ Industrial water use figures were obtained from the University of Utah, Bureau of Economic Research.
2/ Diverted at headgate.
3/ Maximum municipal demand is calculated as 1.5 the average daily use.
4/ Maximum irrigation demand is calculated at 26 percent of the yearly demand and converted to a daily use.

NOTE: Flow regulation water is not included in this table; see Table XIII.

TABLE XII. PROJECTED PRICE CITY AND ADJACENT AREAS
MUNICIPAL AND INDUSTRIAL WATER DEMAND
PRICE RIVER BASIN, 1960-2060

Description	1960	1970	1980	1990	2000	2020	2060
Population	13,628	15,800	20,800	28,300	36,100	39,800	50,100
Per Capita Use - GPCD	225	240	250	260	270	280	300
Municipal Water Use - MGD	3	4	5	7	10	11	15
Industrial Water Use - MGD	3	6	9	15	27	29	34
Total Daily Demand - MGD	6	10	14	22	37	40	49

Industrial

Industrial water use is expected to be closely related to projected economic activity. Particularly important in this development will be construction of a coal slurry pipeline, establishment of a coal liquification industry, and increase in steam power generation and expected development of the oil-shale industry. Increases in manufacturing are not expected to exert a major requirement for water in quality or quantity since this activity will likely be for low water requirement durable and non-durable production.

Irrigation

Agricultural irrigation requirements are expected to level off at 50,000 acre-feet annually in the future.

ANTICIPATED WASTE DISCHARGES

Most of the municipal and industrial development in the Price River Basin is expected to occur in the area near Price, Utah. Irrigated areas would be expected to remain in and around those areas now irrigated.

At present municipal waste discharges cause quality problems in the Price River during low flows. To correct this, the area from Helper to Wellington has formed a sanitary district to include a collection system and treatment facilities. The discharge of these wastes is to be below Wellington. When this plan is carried out, there should be little quality problem in the river from municipal discharges, but as the discharges increase over the years, dilution water will be necessary to maintain a 2 ppm dissolved oxygen content in the stream below Wellington. A minimum of 2 ppm dissolved oxygen is considered necessary in order to avoid nuisance conditions.

Some of the future industrial development is expected to affect water quality in the Price River while others will not. No wastes are expected to result from the coal pipeline project. Water needed in the mining of oil shale would be consumptive, while shale retorting operations would require a small amount of water for cooling bearings and sanitary water for the employees. The sewage district facilities would probably be used for these wastes. Since refining of the oil is not expected to take place in the Price River Basin, refinery wastes should not be a problem.

The steam electric power plants would be expected to discharge blowdown water from their cooling processes, containing some conditioning chemicals. These discharges are not expected to adversely affect other water uses downstream, but will add phosphate and sludge residue to the water.

Coal liquification processes would produce the most significant industrial waste. The wastes would probably contain phenols, ammonia, biochemical oxygen demand and other constituents. With the normal chemical and biological methods for treating or removing the constituents from the wastes, there would still be a distinct effect on the Price River after the wastes are discharged and additional dilution water would be required. The concentrations of pollutional materials would undoubtedly affect water uses below this industrial discharge. It is assumed that this discharge to the Price River will occur below Wellington starting in the year 1990.

FUTURE WATER QUALITY CONSIDERATIONS

STREAM CLASSIFICATION

The Utah Water Pollution Control Board adopted 'The Standards of Quality and the Regulations for Water Classification' on November 19, 1954. These were made official by order of the Board February 25, 1955, and amended by order of the Board September 7, 1960[1/].

Although the Price River has not yet been officially classified, discussions with officials of the Utah State Water Pollution Control Board indicate that it is planned to classify Price River as a Class C stream[2/]. The Class C regulations and standards are listed in the Appendix.

MUNICIPAL AND INDUSTRIAL WASTES

The effluent from the proposed sewage treatment plant below Wellington is not expected to affect other water uses,[3/] as none are expected in the Price River below this discharge. However, this treated sewage effluent is expected to cause some problem in the future since its introduction into the stream will result in a low dissolved oxygen level below the point of discharge. Calculations indicate that during warm, low flow periods (less than one cubic foot per second) the dissolved oxygen will be approximately zero and will only recover to approximately 3 ppm at the confluence of the Price and Green Rivers. If, for example, it is required to maintain a minimum of 2 ppm dissolved oxygen below Wellington a volume of dilution water of approximately two times the volume of sewage would be required for dilution. Thus, if the discharge of treated sewage were 7 cfs, then an additional 14 cfs would be needed.

1/ Utah Water Pollution Control Board, The Standard of Quality and the Regulations for Water Classification, op. cit.

2/ Personal interview with Executive Secretary, Utah Water Pollution Control Board.

3/ It has been assumed that the sewage effluent will be discharged at a point below the intake for Farnham Ditch and the Wellington Coal Washing Plant or that these intakes will be moved upstream of the point of discharge if necessary.

EFFECTS OF OTHER WATER DEVELOPMENT PROJECTS

The Sanpete Project, proposed by the U. S. Soil Conservation Service, would divert Price River water near the headwaters for use across the divide in the Sanpete area. This diversion may affect quality in the Price River as well as flow. The significance of such effects should be considered in the analysis of the Sanpete Project.

STREAMFLOW REGULATION REQUIREMENTS

Natural streamflow in the Price River below Gordon Creek decreases sharply during the summer months because of use by agricultural irrigation. The flow then increases gradually moving downstream, with the addition of municipal and industrial wastes, and irrigation return flows. The quality of this water below Gordon Creek would continue to be poor, even after the proposed treatment of municipal and industrial wastes since the irrigation and natural conditions produce high concentrations of dissolved solids. There is no future economic activity projected along the Price River below Wellington. All future needs for suitable quality water are expected to be met from the Price River above Price, Utah. Since there is little fishing or other recreational activity below Wellington on the Price River, it will only be necessary to protect against nuisance conditions.

The Utah Water Pollution Control Board has not officially classified the Price River and since this survey by the Public Health Service disclosed no beneficial uses of river waters below Wellington (except for diversion for a coal washing plant and Farnham Ditch), a minimum dissolved oxygen content of 2 ppm is considered sufficient to prevent nuisance conditions in the river, and has been adopted for purposes of this study.

The waters of the Price River Basin by themselves are not expected to have a significant effect on the Green River in view of their relative flows. The effect on the Green River of the Price River combined with the inflows from the many other tributaries has not been studied in this report.

To maintain a minimum of 2 ppm dissolved oxygen at least 90 percent of the time in the river below Wellington, dilution water will be required when sewage discharges are greater than 5 cfs. Table XIII indicates the approximate amounts of dilution water required below Wellington for the various projected periods until 2060. No value has been computed for the above dilution water requirements, since the amount needed is to avoid nuisance conditions in the river and at this time no downstream beneficial uses are anticipated from which net benefits could be calculated. However, the minimum value can be considered equal to the cost of storage for this purpose. The cost has not been calculated since cost data are not yet available. The preliminary calculations would correct the oxygen deficiency but there would still remain the

problem of high total dissolved solids present in the Price River below the confluence with Gordon Creek. To reduce the high levels of total dissolved solids in the Price River at Woodside by using water from the upper basin (approximately 250 ppm total dissolved solids) for dilution, would require 700,000 acre-feet annually of dilution water for a reduction in total dissolved solids to 500 ppm and 200,000 acre-feet of water annually to reduce the level to 1,000 ppm.

TABLE XIII. DILUTION WATER REQUIRED TO MAINTAIN 2 ppm DISSOLVED OXYGEN BELOW WELLINGTON

Year	Price Area M&I Use[1] - cfs	50% Return[2] in cfs	Percent of Time Dilution Requirements are met by Natural Flow[3]	Acre-feet of Storage Required[4]
1960	6.2	3.1	90%	-
1970	7.75	3 9	90%	-
1980	10.8	5.4	89%	-
1990	18.6	9.3	60%	1,900
2000	35.6	17.8	20%	8,400
2020	40.0	20.0	17%	11,300
2060	50.0	25.0	14%	17,500

[1] Price area municipal and industrial water use figures do not include water used for mining, steam electric and the proposed coal pipeline.

[2] It is assumed that only 50 percent of the water withdrawn is returned.

[3] Percent of time is taken from a daily duration curve of flows from 1950-1957 at a USGS stream gaging station located east of Wellington. This is an extremely short record but includes a wet and dry period and is considered an indication of conditions for this preliminary study.

[4] These storage values do not include conveyance losses, evaporation, etc., and were calculated on an annual basis.

BIBLIOGRAPHY

1. F.R. Clark, Economic Geology of the Castle Gate, Wellington and Sunnyside Quadrangles, Carbon County, Utah, U.S. Dept. of Interior, Geological Survey, Survey Bulletin 793, Washington, D.C., 1928.

2. Intermountain Association of Petroleum Geologists, Geology and Economic Deposits of East Central Utah, 7th Annual Field Conference, Salt Lake City, Utah, 1956.

3. Final Report - Engineering Advisory Committee to Upper Colorado River Basin Compact Commission, Denver, Colorado, November 29, 1948.

4. U.S. Department of Interior, Geological Survey, Surface Water Supply of the United States, WSP 1713, Washington, D.C., 1961.

5. Templeton & Linke, Consulting Engineers, Price City, Utah - Report on Water Supply, Salt Lake City, Utah, 1957.

6. Thomas Harvey, Water Commissioner, Price River System Water Distribution Report, Price, Utah, 1960 and 1961.

7. MacKechan & Kremmerer, Estimated Use of Water in the United States, 1960, U.S. Dept. of Interior, Geological Survey, C-456, Washington, D.C., 1961.

8. Ralph Porges, "Factors Influencing Per Capita Water Consumption," Water & Sewage Works Journal, May 1957.

9. Section 2, (b) Federal Water Pollution Control Act, Public Law 660 - 84th Congress, as amended by PL 87-88, approved 7/20/61.

10. U.S. Dept. of Commerce, Bureau of Census, United States Census of Population: Utah, 1960, "Number of Inhabitants," PC(1), 46C, U.S. Government Printing Office, Washington, D. C., 1961.

11. Utah Dept. of Employment Security, Annual Report, 1960, Salt Lake City, Utah, October 1961.

12. Eastern Utah Inc. and Utah Committee on Industrial and Employment Planning, Industrial Survey of Carbon and Emery Counties in Utah, undated.

13. O.L.Harline, "Carbon-Emery Counties, A Critical Utah Unemployment Area with Long-Term Growth Prospects," Utah Economic and Business Review, Vol. 21, No. 12, University of Utah, Salt Lake City, Utah, December 1961.

14. "Layoff to Cut 130 Jobs in Carbon Area," Salt Lake City Tribune, March 2, 1962.

15. U.S. Dept. of Interior, Bureau of Mines, 1960 Minerals Yearbook, Vol. II, "Mineral Fuels," U.S. Government Printing Office, Washington, D.C., 1961.

16. P.A. Veritt and L.R. Berryhill, Coal Resources of the United States, Progress Report, U.S. Dept. of Interior, Geological Survey, Circular 94, Washington, D.C., December 1950.

17. U.S. Department of Health, Education and Welfare, Public Health Service, 1960 Directory of Manufacturing for the Colorado River Basin, Basic Data Report No. 2, Colorado River Basin Water Quality Control Project, Denver, Colorado, January 1962.

18. _____, 1960 Directory of Mining for the Colorado River Basin, Basic Data Report No. 4, Colorado River Basin Water Quality Control Project, Denver, Colorado, May 1962.

19. Consolidation Coal Company, A New Fuel for California's Electric Utilities, Library, Pennsylvania.

20. Carbon-Emery Industrial Development Bureau, A Provisional Summary, Overall Economic Development Program for the Carbon-Emery Counties Redevelopment Area of Utah, (Prepared for the Area Redevelopment Administration, U. S. Dept. of Commerce), Price, Utah, October 1961.

21. "Intermountain Oil Log," Salt Lake City Tribune, March 4, 1962.

22. U.S. Dept. of Commerce, Bureau of Census, U.S. Census of Agriculture: Utah, 1959, Vol. 1, Part 44, U.S. Government Printing Office, Washington, D.C., 1961.

23. Consolidation Coal Company, Coal by Pipeline - Handbook of Facts, Pittsburgh, Pennsylvania.

24. U.S. Dept. of Interior, Bureau of Reclamation, Statistical Appendix to Crop Report and Related Data, Annual Reports, Federal Reclamation Projects, Washington, D.C. 1950-1960.

25. R.R. Edminister, et al, An Economic Study of the Proposed Canyonlands National Park and Related Recreation Resources, (Prepared for the National Park Service, U.S. Dept. of Interior,) Bureau of Economic and Business Research, College of Business, University of Utah, Salt Lake City, Utah, March 1962.

26. Ward J. Roylance, Tour the Different World of Utah's Castle Country, Utah Tourist and Publicity Council - Carbon and Emery County Civic Groups, Salt Lake City, Utah.

27. K.C. Nobe and G.G. Collins, A Preliminary Economic Base Study of the Animas-LaPlata Pilot Project Watersheds in the Four Corners Area of the Colorado River Basin, Colorado River Basin Water Quality Control Project, U.S. Public Health Service, Region VIII, Denver, Colorado, July 1962.

28. State Tax Commission of Utah, Schedule of Sales and Use Tax Collections, Industrial Classifications by County, Salt Lake City, Utah, 1961.

29. U.S. Dept. of Agriculture, Soil Conservation Service, Watershed Work Plan North Sanpete Watershed, Sanpete County, Utah, Salt Lake City, Utah, September 1961.

30. Steven Stutz and Claron Nelson, Utah Mineral Resources, Bureau of Economic and Business Research, College of Business, University of Utah, Salt Lake City, Utah, November 1961.

31. Title III, Water Supply Act of 1958, Public Law 500, 85th Congress.

32. Utah State Department of Health, Chemical Analyses on Municipal Water Supplies of Utah, Salt Lake City, Utah, 1953.

33. A. R. Gaufin, Limnological Analyses of Jordan, Price, Provo, and Weber Rivers, University of Utah, Salt Lake City, Utah, 1957.

34. A. R. Gaufin, Report on Limnological and Sanitary Characteristics of Jordan, Price, Provo and Weber Rivers for 1957-1958, University of Utah, Salt Lake City, Utah.

35. John A. Ward and Clarence M. Skonbye, Flow Characteristics and Chemical Quality of the Waters of a Section of Price River, Carbon County, Utah for the Years 1957 and 1958, Utah State Water Pollution Control Board, Salt Lake City, Utah.

36. Office of the Utah State Engineer, A Compilation of Chemical Quality Data for Ground and Surface Waters in Utah, Technical Publication No. 10, Salt Lake City, Utah, 1958.

37. U. S. Dept. of Interior, Geological Survey, Quality of Surface Waters of the United States, Selected Issues of the Water-Supply Papers, U. S. Government Printing Office, Washington, D. C.

38. Department of Health, Education and Welfare, Public Health Service, Interstate Quarantine Drinking Water Standards, Washington, D.C., approved Feb. 28, 1962.

39. Utah Water Pollution Control Board, The Standards of Quality and the Regulations for Water Classification, adopted by the Utah Water Pollution Control Board, Salt Lake City, Utah, November 19, 1954; amended by Order of the Board, September 7, 1960.

APPENDIX

Item D-1

STANDARDS OF QUALITY AND THE REGULATIONS FOR CLASS C WATERS, STATE OF UTAH

Class "C" waters shall be so protected against pollution as to be suitable at all times for domestic water supplies which are treated before use by coagulation, sedimentation, filtration, and disinfection. Class "C" waters shall be suitable without treatment for irrigation, stock watering, fish and wildlife propagation, recreation (except swimming), as a source for industrial supplies, and for other uses, as may be determined by the Board.

Regulations & Standards: No person shall discharge into Class "C" waters any wastes.

(1) which result in chemical characteristics of said waters exceeding the limits prescribed by U.S. Public Health Service Drinking Water Standards as of February 6, 1946, or

(2) which result in chemical characteristics of said waters exceeding the recommendations for irrigation water quality as outlined in Chapter 5 of the U.S. Department of Agriculture "Agriculture Handbook No. 60," issued February, 1954, or

(3) which result in a monthly arithmetical average "most probable number" (MPN) of coliform organisms in said waters exceeding 5,000 per 100 milliliters; or in an MPN exceeding this number in more than 20 percent of the samples collected during any month; or in an MPN exceeding 20,000 per 100 milliliters in more than 5 percent of such samples, or

(4) which result in a monthly arithmetical average biochemical oxygen demand (BOD) in said waters exceeding 5 parts per million (p.p.m.); or in a BOD exceeding this amount in more than 20 percent of the samples collected in any month; or in a BOD exceeding 10 p.p.m. in more than 5 percent of such samples, or

(5) which result in any slicks, floating solids, suspended solids or sludge deposits in said waters which are readily visible, or which result in an appreciable change in color of said waters, or

(6) which result in a pH of said waters lower than 5.0 or greater than 9.0, or

(7) which contain any toxic wastes, phenols, or other deleterious substances in such concentrations or at such temperatures as will render said waters injurious to fish life and waterfowl, or unsafe or suitable as sources of water supply for domestic use, food processing or industrial use, or unsuitable for agricultural purposes, stock watering, or recreation (except swimming).

The following notes were adopted as modifications to The Standards of Quality and The Regulations for Water Classification on Sept. 7, 1960, and are hereby made a part of said standards and regulations.

NOTE 1: The Board may assign any one of the foregoing classifications to a given water notwithstanding the presence in said water of natural pollutants in excess of limits established by the classification, in which case the subscript "1" shall be added to the usual classification designation (A_1, B_1, C_1, etc.) to denote the modification of water quality. No change in waste discharge restrictions of the basic classification shall be inferred, except that the discharge of any wastes in such a way as to increase the concentration of any of the excessive natural pollutants in the classified water is prohibited.

NOTE 2: Wastes discharged to waters of the state under limitations imposed by a given classification shall be further controlled as required to protect water quality designated by all downstream classifications.